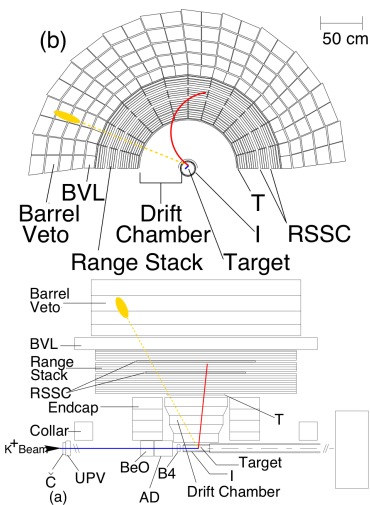


# Range Stack Technologies (no costs, mostly questions)

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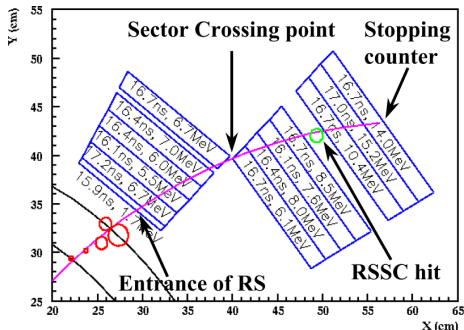
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# E949 range stack



- ▶ 24 azimuthal sectors. 19 radial layers.
- ▶ Layer 1 : 0.64cm thick, 52 cm long, 17 1-mm WLS fibers(Bicron multiclاد BCF-92), Hamamatsu R1398 PMT on each end
- ▶ Layers 2-18(19): 1.9(1.0)cm thick, 182 cm long, lucite light guides, EMI 9954KB PMT on each end
- ▶ Each PMT: Passive split 1:2:2 for ADCs:discriminator: fan-in. Discriminator to TDC and trigger. 4 neighboring sectors fanned-in to single 500 MHz waveform digitizer.
- ▶  $\sim 10$  PE/MeV
- ▶ straw chambers (RSSC) outside layers 10 and 14.

## E949 range stack(2)



Uses of range stack:

1. Measure track range and energy
2.  $dE/dx$  provides  $\pi/\mu$  discrimination
3.  $\pi \rightarrow \mu \rightarrow e$  detection in stopping counter
4. Photon veto
5. Trigger

# Desired range stack improvements

1. WFD, ADC and multi-hit TDC for each PMT: Reduce effect of accidentals on  $\pi/\mu$  discrimination
2. Increased light yield: Improve energy resolution, photon veto capability and  $\pi/\mu$  discrimination
  - ▶ Improved coupling to photon detector
  - ▶ Photon detector with higher QE
3. Increased segmentation: Lowers accidental losses
  - ▶ Radial:
    - 3.1 Improve discrimination between min.ion. track and 3 MeV  $\mu^+$  from stopped  $\pi^+$
    - 3.2 Improve range resolution
  - ▶ Azimuthal:
    - 3.1 Improve position resolution (no RSSCs)
    - 3.2 Improve  $e^+$  detection

## Issues with increased segmentation

1. Mechanical feasibility
2. Cost: Requires more photon detectors
3. Increases inactive material in range stack
4. Increases probability that  $\mu^+$  escapes stopping counter

In E949, counters in 4 layers were packaged with 1 mil Al between layers and wrapped in 1 mil Al.



# Minerva-style scintillator

## Pros:

1. Factory at FNAL
2. Reliable, robust extrusion technique

## Cons:

1. Estimated light yield  $\sim 9$  PE/MeV (based on Minerva TDR), not a significant improvement over E949
2. Co-extrusion of very thin coating ( $\sim 25\mu$ ) not feasible ( $> 130\mu$  for Minerva) based on e-mail exchange with Anna Pla-Dalmau.
3. Transverse dimensions of extrusion changes with die wear.
4. Variation of light collection efficiency with track position ( $\pm 10$  from Minerva simulation)